Report No. 66-1-31

5230

November 1966

EVALUATION OF OAK MORTALITY ON THE GEORGE WASHINGTON AND JEFFERSON NATIONAL FORESTS VIRGINIA

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INTRODUCTION

Aerial and ground surveys to determine the status of a decline and mortality of oaks were conducted on the George Washington and Jefferson National Forests in Virginia. These surveys were conducted during the period September 8 - 15 and October 2 - 4, 1966, subsequent to reports of widespread oak mortality on these forests. The authors were assisted in these surveys by C. A. Rodamer and N. H. Plaugher of the George Washington National Forest and Walter Morrill of the Jefferson National Forest.

The results of this survey indicate that extensive mortality is present in varying degrees of intensity over approximately 104,000 acres on the George Washington and at least 5,900 acres on the Jefferson National Forest. The mortality is confined primarily to the scarlet oak, *Quercus coccinea* Muenchh., although some mortality of other species in the red oak group was observed.

METHODS

A Cessna 182 was used for the aerial surveys. The surveys were flown at an average airspeed of 95 mph at an elevation of approximately 1,000 feet above ground surface. The flight line interval was approximately three miles facilitating 70 percent coverage of the areas.

Oak mortality was classified from the air according to the following categories:

Scattered - Less than five percent visible crown mortality

Moderate - Five to 40 percent visible crown mortality

Heavy - Forty percent and over visible crown mortality

All of the above percentages are expressed as proportion of dead to living crowns.

The aerial survey included all land within the National Forest boundary, i.e. the oak mortality on intermingled private land within the forest boundary was also mapped and tallied in final acreage estimates.'

Several areas of oak mortality on the Broadway District of the George Washington National Forest and the Blacksburg District of the Jefferson National Forest were examined to determine the causal agent(s) responsible for the condition.

RESULTS

Host Affected - Scarlet oak, *Quercus coccinea* was the primary oak species affected. Some dying red, *Q. falcata* Michx. and black, *Q. velutina* Lam. oaks were observed but their occurrence and number was negligible.

Location and Intensity of Mortality - Varying degrees of scarlet oak mortality were observed on all districts of the George Washington National Forest (Figs. 1 - 5).

Areas of mortality ranged from 150 to 6,000 acres in size and averaged 1,400 acres per individual area. The most extensive mortality occurred on the James River District where approximately 28,000 total acres were affected in fourteen spots. The Pedlar District showed the least mortality. Six areas were detected totaling some 1,300 acres of mortality (Table 1). Scattered mortality (less than five percent) was observed forest wide.

The areas of oak mortality reported by the Jefferson National Forest and subsequently surveyed totaled 5,840 acres (Figs. 6 - 7). The size of areas with oak mortality ranged from 280 to 1,200 acres and averaged 735 acres per area. The most extensive mortality of the districts surveyed occurred on the Wythe District where 3,800 acres contained mortality. The least extensive mortality occurred on the New Castle District where only 280 acres were recorded as affected (Table 2). These figures are believed to be low since aerial detection of mortality other than that reported was impossible due to fall coloration.

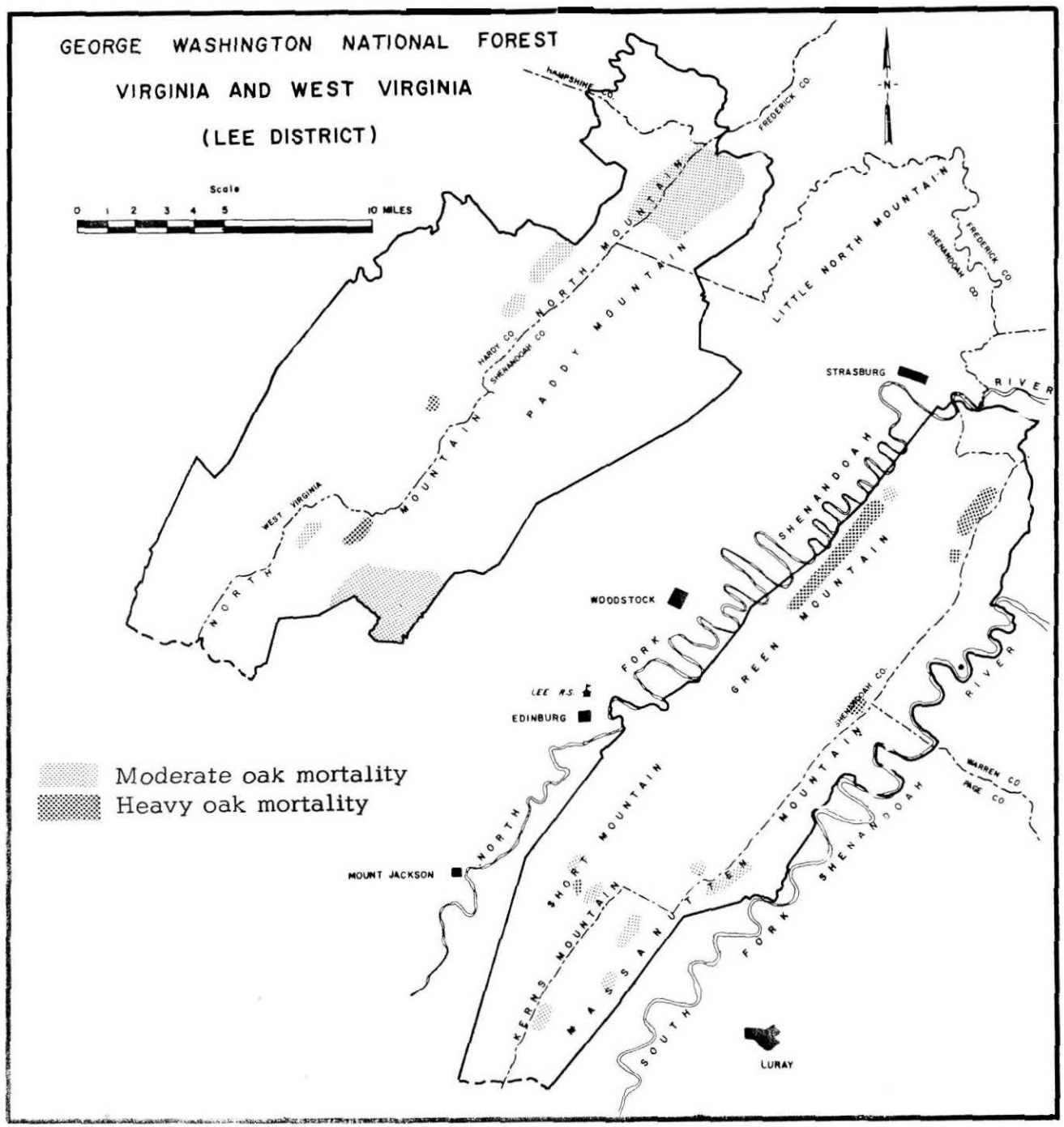

Fig. 1-Location of oak mortality, Lee District
George Washington National Forest
September 1966

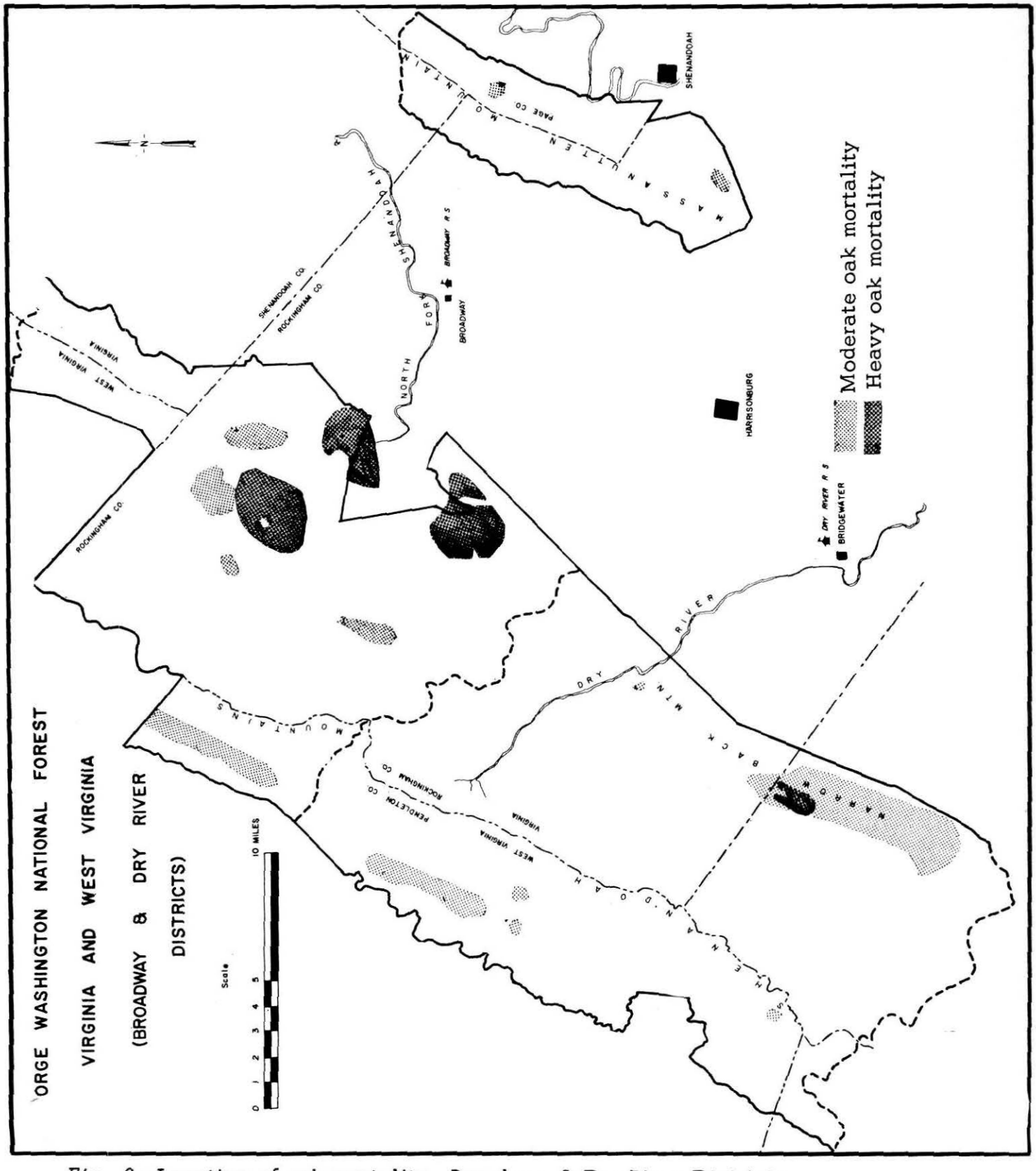

Fig. 2- Location of oak mortality, Broadway & Dry River Districts, George Washington National Forest, September 1966

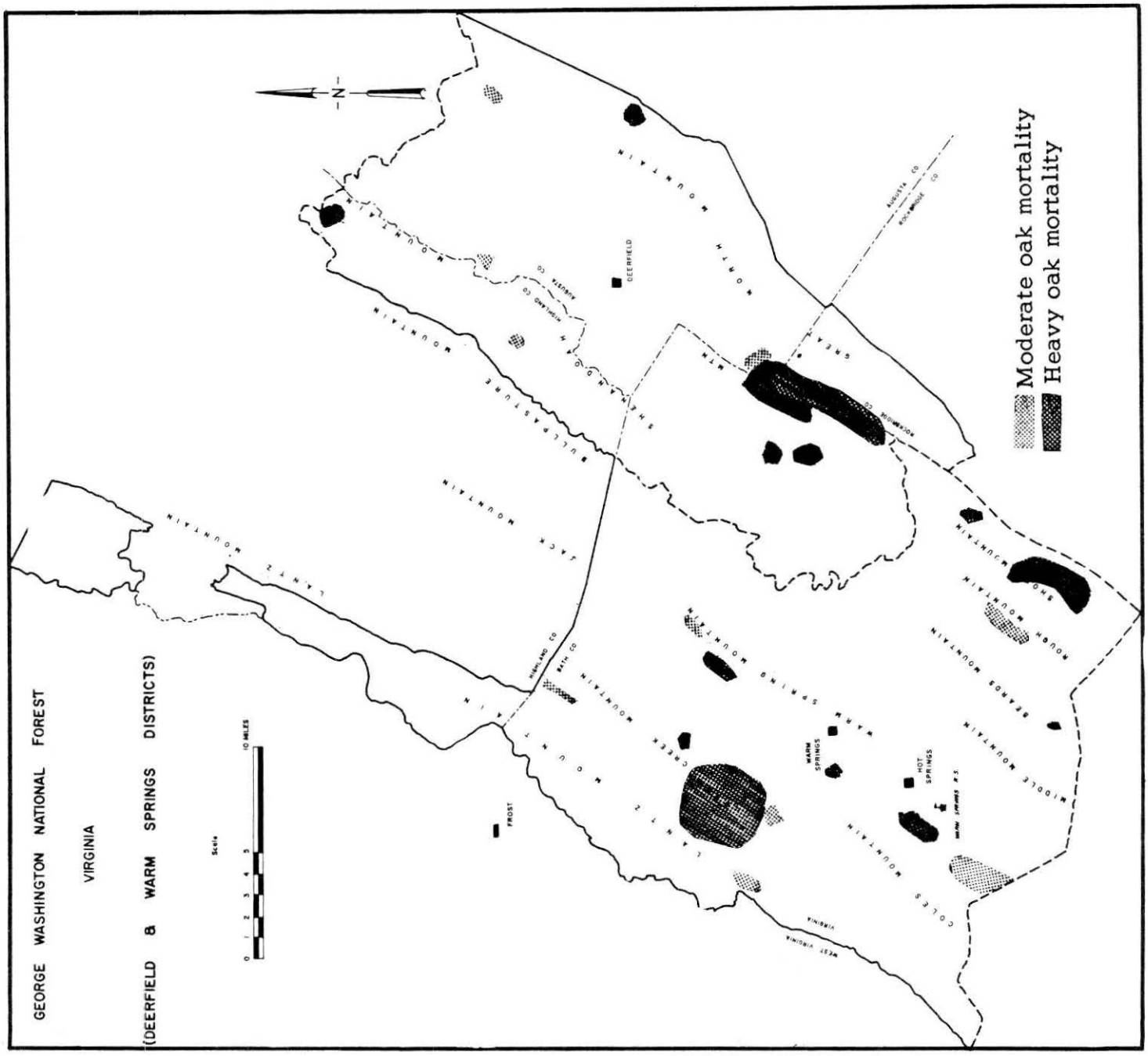

Fig. 3 - Location of oak mortality, Deerfield and Warm Springs Districts, George Washington National Forest
September 1966

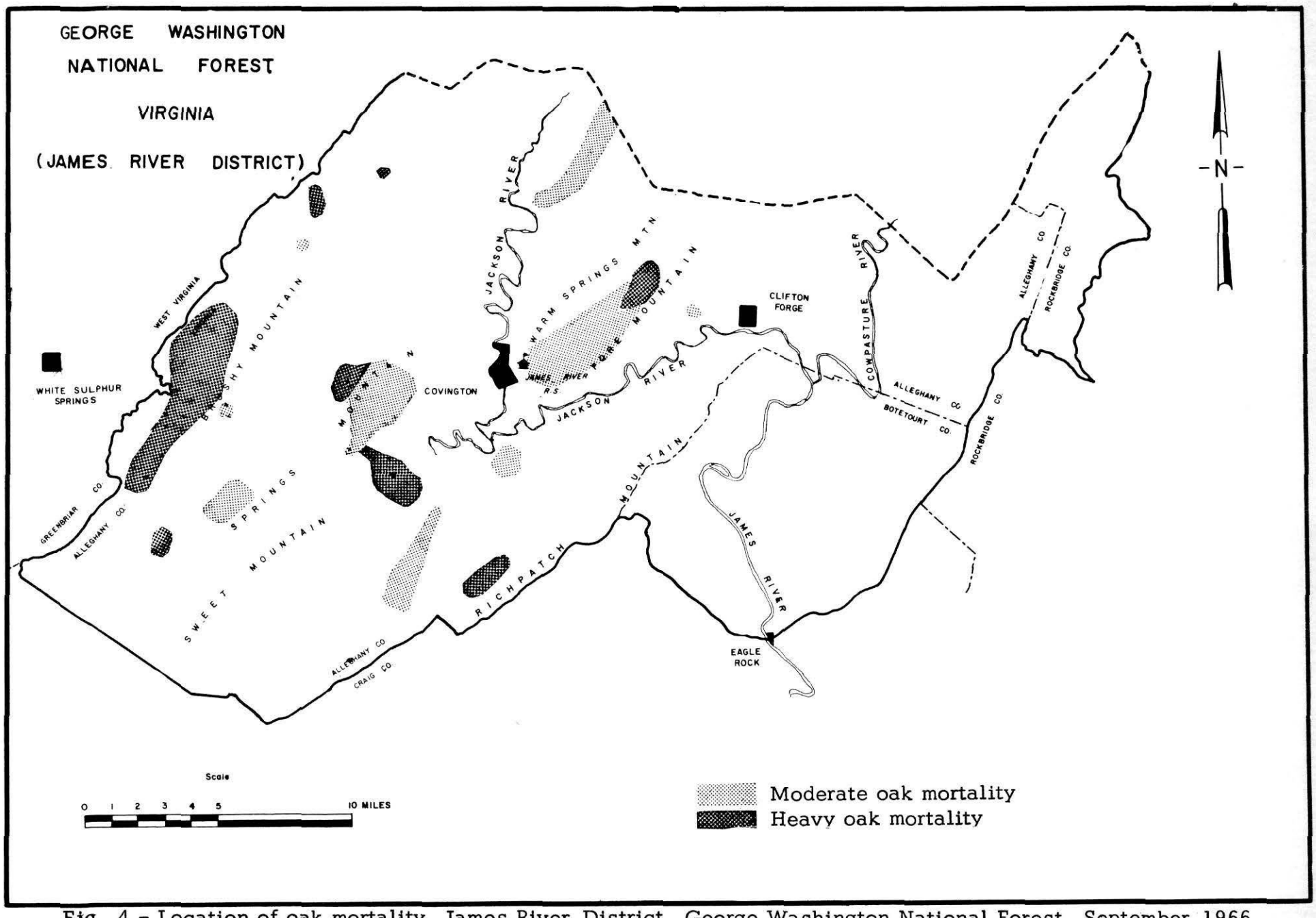

Fig. 4 - Location of oak mortality, James River, District, George Washington National Forest. September 1966

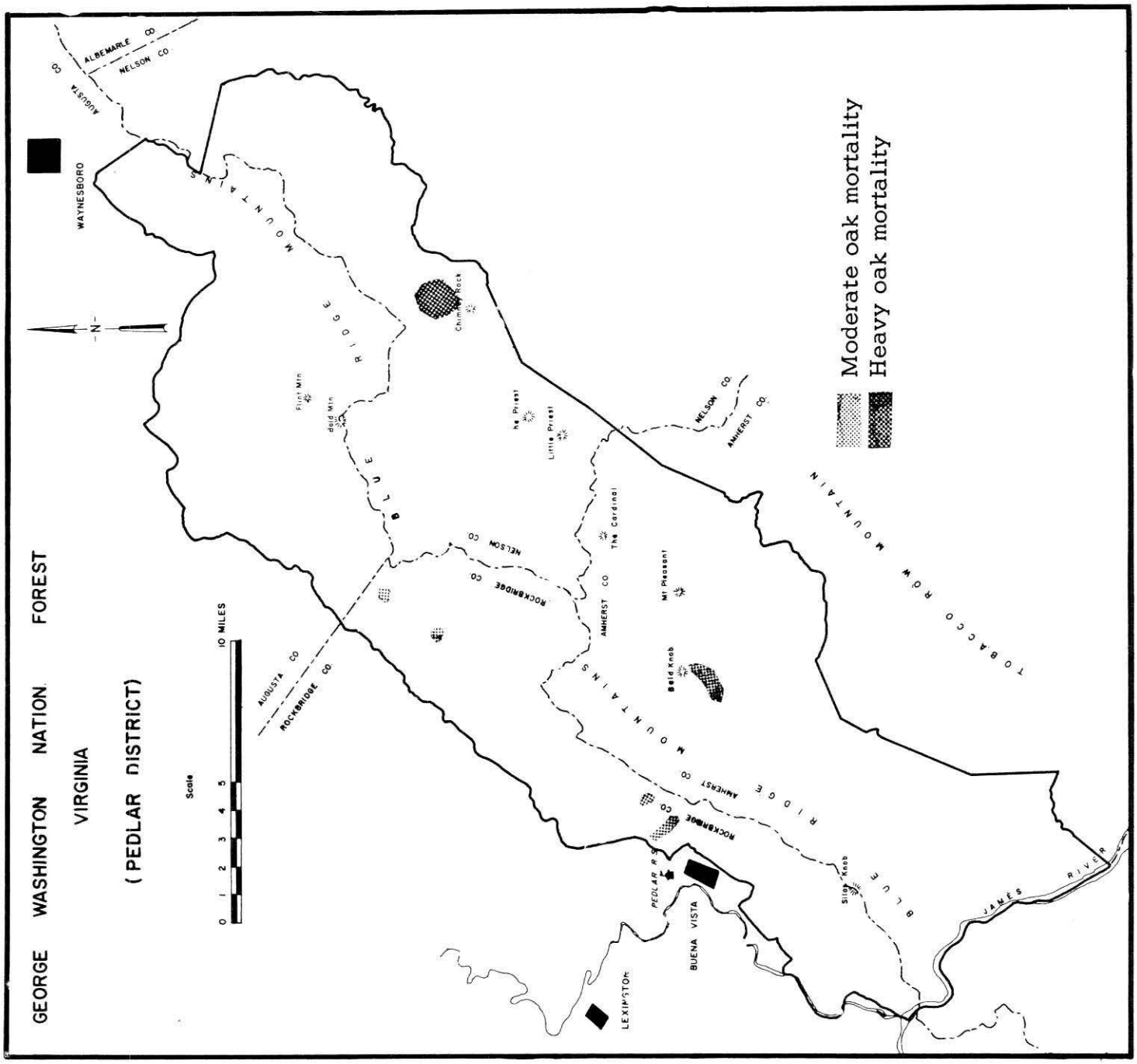

Fig. 5 - Location of oak mortality, Pedlar District
George Washington National Forest
September 1966

Table 1 - Area of oak mortality, George Washington National Forest, Virginia - September 1966

District	Moderate Mortality (Acres)	Heavy Mortality (Acres)	Total
Broadway	9,120	10,800	19,920
Deerfield	960	9,200	10,160
Dry River	15,100	1,100	16,200
James River	13,000	14,600	27,600
Lee	6,300	6,500	12,800
Pedlar	800	520	1,320
Warm Springs	5,800	10,000	15,800
Total	51,080	52,720	103,800

Table 2 - Area of oak mortality, Jefferson National Forest, Virginia - October 1966

District	Acres of Oak Mortality
Blacksburg	1,760
New Castle	280
Wythe	3,800
Total	5,840

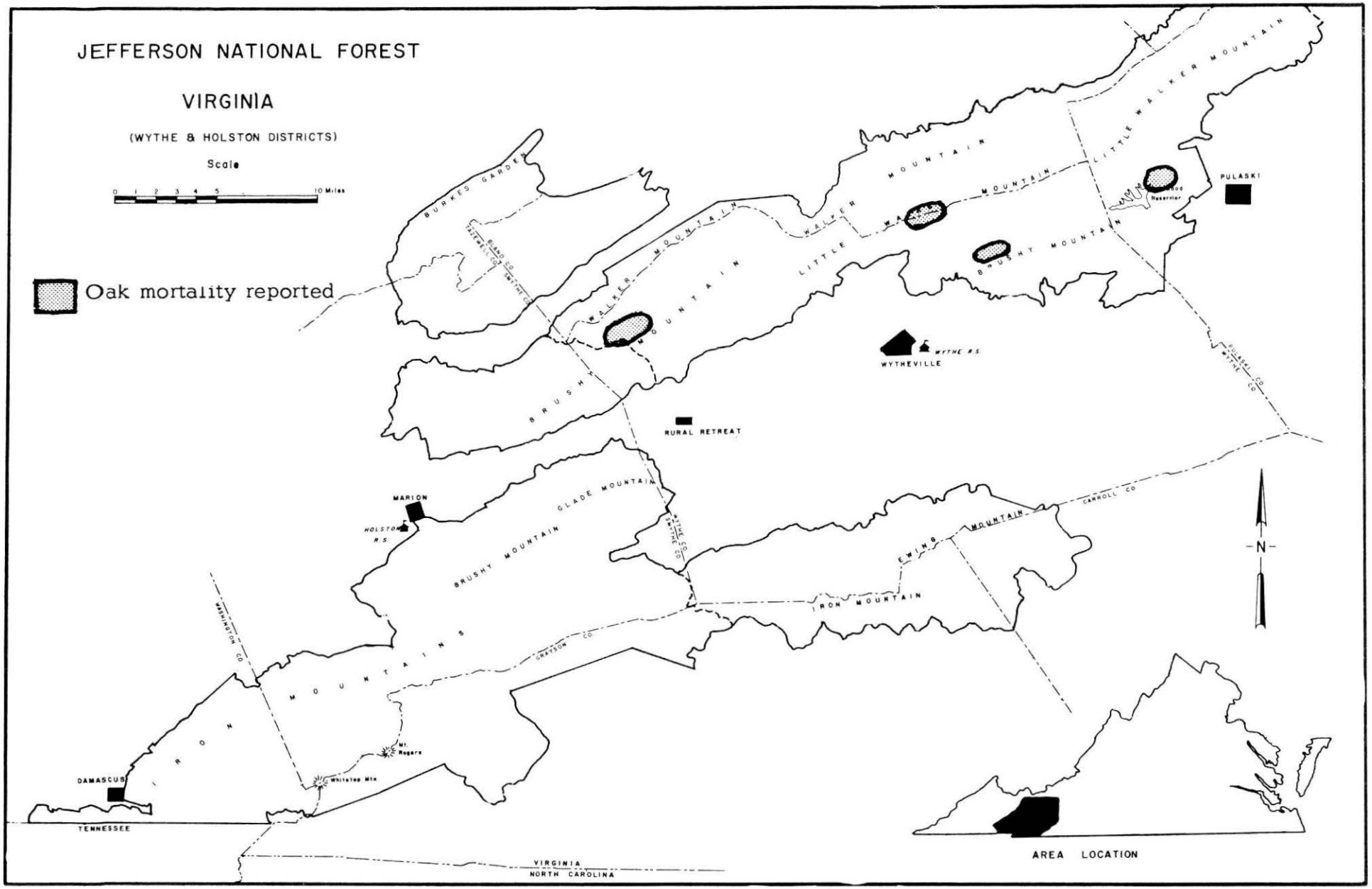

Fig. 6. - Location of oak mortality, Wythe & Holston Districts, Jefferson National Forest, October 1966

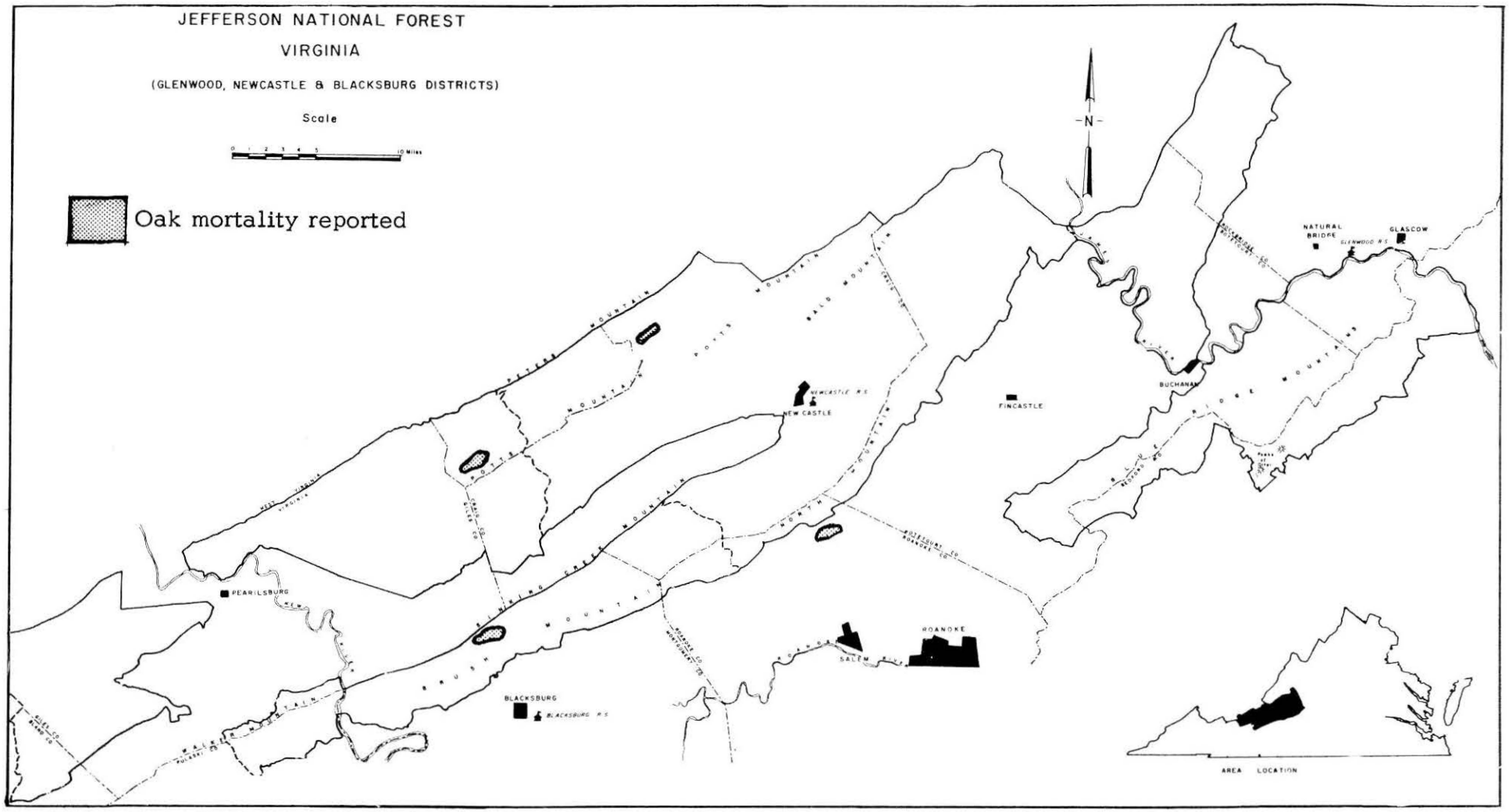

Fig. 7 - Location of oak mortality, Glenwood, Newcastle & Blacksburg Districts, Jefferson National Forest October 1966

Biological Data - Examination of the bark of dead and dying trees revealed heavy larval infestations of *Agrilus* sp., probably *bilineatus* Web, (Coleoptera: Buprestidae). This insect generally attacks trees which have been subjected to some weakening effect such as drought, frost, fire, insect defoliation, root disease or other causes that might ultimately have brought about the death of the tree (Craighead 1950). Considerable study by other workers agree that this insect does no more than hasten the death of already dying trees. Vigorous trees are capable of resisting attack by this insect.

Shoestring root rot, *Armellaria mellea* (Vahl.) Quel. was observed on a single dying scarlet oak on the George Washington National Forest. Boyce (1961) states that this fungus does not infect thrifty trees and that trees of reduced vigor are most liable to attack. Day (1929) states further that *A. mellea* is parasitic only when the vigor of the host has been reduced by unfavorable conditions, particularly poor soil, acting alone or in conjunction with other injurious agents.

Evidence of insect defoliation was observed on the foliage of the dead and dying trees. The specificity of feeding damage on scarlet oak suggests that the leaf tier, *Croesia semipurpurana* (Kearfott) (Lepidoptera: Tortricidae), may be the causal agent responsible. Two areas of mortality on the James River District of the George Washington National Forest coincide with the boundaries of an infestation of *C. semipurpurana* which has occurred annually in these areas for at least two years (Fig. 8) (Rauschenberger, *et al.* 1966). A late spring frost in the Southern Appalachians during 1966 prevented an effective survey for hardwood defoliators and it is very likely that additional infestations of *C. semipurpurana* occurred in this area.

Early spring defoliation by an unidentified insect was reported on the Broadway District of the George Washington National Forest where extensive mortality also occurred.

Environmental Factors - Mortality was not confined to any specific site, elevation, slope or aspect, but most of the areas had a low site index.

A late spring frost on May 10 - 11, 1966 set new record lows in temperature for so late in the season over most of Virginia. Extensive frost damage to foliage of orchard, shade and forest trees occurred throughout the Southern Appalachians.

Drought conditions of varying severity have prevailed throughout the western portions of Virginia since 1959. In 1965, the year preceding the mortality, thirteen weather stations in the central mountain section of Virginia, which encompass the George Washington National Forest, recorded an average annual precipitation deficit of -7.90 inches. Precipitation deficits ranged

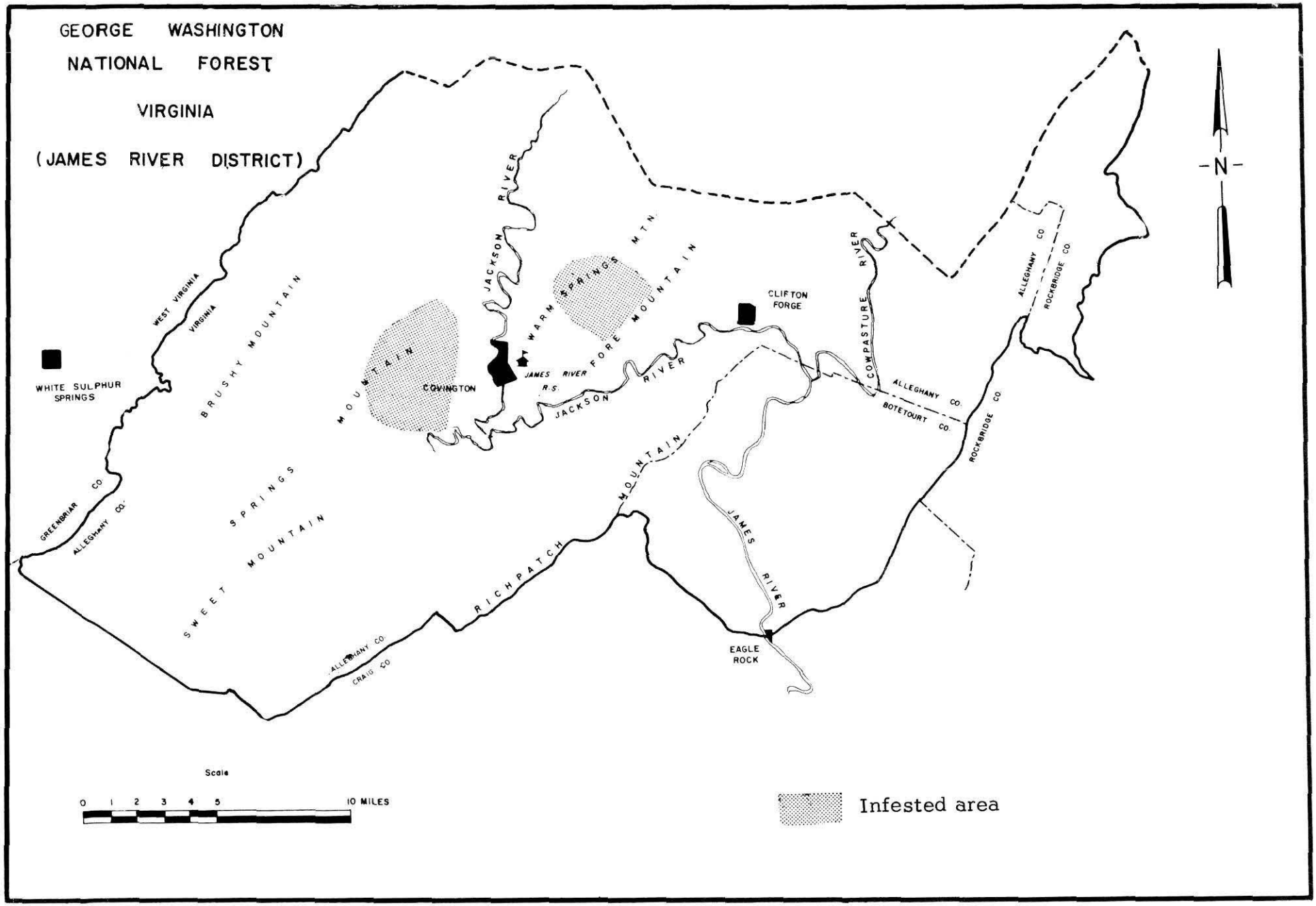

Fig. 8 - Location of Croesia semipurpurana infestation - 1966

from a minimum of -1.89 inches at North River Dam, Virginia to a maximum of -12.39 inches at Buchanan, Virginia. Also in 1965, nine weather stations in the southwestern mountain section of Virginia, which encompass the Jefferson National Forest, recorded an average annual precipitation deficit of -7.53 inches. The deficits ranged from a minimum of -3.47 inches in Damascus, Virginia to a maximum of -13.05 inches in Pennington Gap, Virginia. The precipitation deficits occurred between late May and December.

DISCUSSION

The primary causal agents believed responsible for the mortality is a combination of an early spring defoliation, due to either insects and/or frost, and late summer moisture stress. Defoliation by insects and/or frost decreases the production of starch by reducing the rate of photosynthesis. In addition, the defoliation provides a drain on starch reserves by requiring the tree to regenerate new leaves. Moisture stresses also tend to reduce photosynthetic activity which consequently reduces the availability of carbohydrate reserves required for maintenance and growth (Loustalot 1945, Heinike and Childers 1936). In short, any climatic or edaphic condition which serves to reduce carbohydrate reserves, either directly or indirectly, becomes one of the many complex factors contributing to the decline and ultimate fate of the tree.

In a study by Staley (1965), ultimate mortality of oaks in a "declined" state was attributed primarily to defoliation by *C. semipurpurana*. Staley's description of "decline" corresponds closely with the symptoms observed in this evaluation namely:

1. Subnormal crown density
2. Yellowing of the foliage followed by wilting and browning
3. Attack by *Agrilus* sp. larvae
4. Retention of withered brown foliage on branches with dieback

Whether the ultimate mortality on the George Washington and Jefferson National Forests was caused primarily by insect, frost, or moisture stress is unknown. The evidence indicates a definite contribution by all three factors, each to an unknown degree. If these conditions continue to prevail, mortality in 1967 could reach the severe levels of this year.

RECOMMENDATIONS

1. Salvage should be initiated as soon as possible in stands of heavy mortality wherever market conditions warrant this feasible.

2. An extensive aerial and ground survey should be scheduled by Forest Insect and Disease Control personnel in June of 1967 to detect infestations of *Croesia semipurpurana* and other spring defoliators possibly contributing to the mortality.

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